

WHAT IS CLAIMED IS:

1 1. For use in wireless network communications system
2 comprising a base transceiver station having an adaptive
3 antenna array and a mobile station having a first mobile
4 antenna and a second mobile antenna, an apparatus for
5 improving downlink performance of said adaptive antenna
6 array of said base transceiver station, said apparatus
7 comprising:

8 a spatial signature estimator associated with said
9 base transceiver station, said spatial signature estimator
10 capable of obtaining a spatial signature from a signal
11 received by said base transceiver station from said first
12 mobile antenna and that is capable of obtaining a spatial
13 signature from a signal received by said base transceiver
14 station from said second mobile antenna; and

15 correlation circuitry coupled to said spatial
16 signature estimator, said correlation circuitry capable of
17 using spatial signatures obtained from said first mobile
18 antenna and from said second mobile antenna to identify a
19 least changing spatial signature, and capable of using said

20 least changing spatial signature to obtain a downlink
21 beamforming weight vector.

1 2. The apparatus as set forth in Claim 1 wherein
2 said spatial signature estimator is capable of obtaining a
3 first set of spatial signatures comprising a first spatial
4 signature from said first mobile antenna and a first
5 spatial signature from said second mobile antenna during a
6 first portion of an uplink interval of a time division
7 duplex slot associated with said first mobile antenna and
8 said second mobile antenna; and

9 wherein said spatial signature estimator is capable of
10 obtaining a second set of spatial signatures comprising a
11 second spatial signature from said first mobile antenna and
12 a second spatial signature from said second mobile antenna
13 during a second portion of said uplink interval; and

14 wherein said correlation circuitry is capable of
15 measuring changes in said second set of spatial signatures
16 with respect to said first set of spatial signatures to
17 identify said least changing spatial signature.

1 3. The apparatus as set forth in Claim 2 wherein
2 said correlation circuitry comprises:

3 a controller;

4 a table coupled to said controller, said table capable
5 of storing values of said spatial signatures;

6 a first spatial correlator coupled to said controller
7 and to said table, said first spatial correlator capable of
8 correlating values of spatial signatures from said first
9 mobile antenna;

10 a second spatial correlator coupled to said controller
11 and to said table, said second spatial correlator capable
12 of correlating values of spatial signatures from said
13 second mobile antenna;

14 a comparator coupled to said controller and to said
15 first spatial correlator and to said second spatial
16 correlator, said comparator capable of comparing
17 correlation values from said first spatial correlator and
18 from said second spatial correlator to determine a downlink
19 beamforming weight vector.

1 4. The apparatus as set forth in Claim 3 wherein
2 said table is a 4M by one table capable of storing values
3 of said spatial signatures, where M is a number of antennas
4 in said adaptive antenna array.

1 5. The apparatus as set forth in Claim 4 wherein
2 said 4M by one table contains:

3 M spatial signatures a^1_p representing a first set of
4 spatial signatures obtained from said first mobile antenna;

5 M spatial signatures a^2_p representing a first set of
6 spatial signatures obtained from said second mobile
7 antenna;

8 M spatial signatures a^1_c representing a second set of
9 spatial signatures obtained from said first mobile antenna;
10 and

11 M spatial signatures a^2_c representing a second set of
12 spatial signatures obtained from said second mobile
13 antenna.

6. The apparatus as set forth in Claim 5 wherein said first spatial correlator calculates a correlation value ρ_1 between said spatial signatures a^1_p and said spatial signatures a^1_c given by:

$$\rho_1 = \left| (a^1_C) * (a^1_P) \right|$$

where the symbol $*$ represents a process of correlation of two signals.

7. The apparatus as set forth in Claim 6 wherein said second spatial correlator calculates a correlation value ρ_2 between said spatial signatures a^2_p and said spatial signatures a^2_c given by:

$$\rho_2 = \left| (a^2_C) * (a^2_P) \right|$$

where the symbol $*$ represents a process of correlation of two signals.

1 8. The apparatus as set forth in Claim 7 wherein
2 said comparator compares said correlation value ρ_1 and said
3 correlation value ρ_2 ;

4 wherein said comparator outputs to said controller a
5 value of zero if said correlation value ρ_1 is greater than
6 or equal to said correlation value ρ_2 ; and

7 wherein said comparator outputs to said controller a
8 value of one if said correlation value ρ_1 is less than said
correlation value ρ_2 .

9 The apparatus as set forth in Claim 8 wherein
said controller selects said M spatial signatures a^1_c as
components of a downlink beamforming weight vector W if
said output value from said comparator is one; and

5 wherein said controller selects said M spatial
6 signatures a^2_c as components of a downlink beamforming
7 weight vector W if said output value from said comparator
8 is zero.

1 10. The apparatus as set forth in Claim 9 comprising
2 a downlink beamformer coupled to said controller, said
3 downlink beamformer capable of receiving said downlink
4 beamforming weight vector W from said controller, and
5 capable of complex multiplying an incoming complex data
6 stream S with said downlink beamforming weight vector W ,
7 and capable of outputting a resulting complex data stream X
8 to transmit portions of M transceivers associated
9 respectively with M antennas of said adaptive antenna
10 array.

1 11. For use in wireless network communications system
2 comprising a base transceiver station having an adaptive
3 antenna array and a mobile station having a first mobile
4 antenna and a second mobile antenna, a method for improving
5 downlink performance of said adaptive antenna array of said
6 base transceiver station, said method comprising the steps
7 of:

8 obtaining in a spatial signature estimator associated
9 with said base transceiver station a spatial signature from
10 a signal received by said base transceiver station from
11 said first mobile antenna;

12 obtaining in said spatial signature estimator a
13 spatial signature from a signal received by said base
14 transceiver station from said second mobile antenna; and

15 using spatial signatures obtained from said first
16 mobile antenna and from said second mobile antenna to
17 identify a least changing spatial signature; and

18 using said least changing spatial signature to obtain
19 a downlink beamforming weight vector.

1 12. The method as set forth in Claim 11 further
2 comprising the steps of:

3 obtaining in said spatial signature estimator a first
4 set of spatial signatures comprising a first spatial
5 signature from said first mobile antenna and a first
6 spatial signature from said second mobile antenna during a
7 first portion of an uplink interval of a time division
8 duplex slot associated with said first mobile antenna and
9 said second mobile antenna; and

10 obtaining in said spatial signature estimator a second
11 set of spatial signatures comprising a second spatial
12 signature from said first mobile antenna and a second
13 spatial signature from said second mobile antenna during a
14 second portion of said uplink interval; and

15 using correlation circuitry to measure changes in said
16 second set of spatial signatures with respect to said first
17 set of spatial signatures to identify said least changing
18 spatial signature.

1 13. The method as set forth in Claim 12 wherein said
2 correlation circuitry comprises:

3 a controller;

4 a table coupled to said controller, said table capable
5 of storing values of said spatial signatures;

6 a first spatial correlator coupled to said controller
7 and to said table, said first spatial correlator capable of
8 correlating values of spatial signatures from said first
9 mobile antenna;

10 a second spatial correlator coupled to said controller
11 and to said table, said second spatial correlator capable
12 of correlating values of spatial signatures from said
13 second mobile antenna;

14 a comparator coupled to said controller and to said
15 first spatial correlator and to said second spatial
16 correlator, said comparator capable of comparing
17 correlation values from said first spatial correlator and
18 from said second spatial correlator to determine a downlink
19 beamforming weight vector.

1 14. The method as set forth in Claim 13 further
2 comprising the step of:

3 storing values of said spatial signatures in said
4 table, wherein said table is a 4M by one table, where M is
5 a number of antennas in said adaptive antenna array.

1 15. The method as set forth in Claim 14 further
2 comprising the steps of:

3 storing in said 4M by one table M spatial signatures
4 a^1_p , representing a first set of spatial signatures obtained
5 from said first mobile antenna;

6 storing in said 4M by one table M spatial signatures
7 a^2_p , representing a first set of spatial signatures obtained
8 from said second mobile antenna;

9 storing in said 4M by one table M spatial signatures
10 a^1_c representing a second set of spatial signatures obtained
11 from said first mobile antenna; and

12 storing in said 4M by one M spatial signatures a^2_c
13 representing a second set of spatial signatures obtained
14 from said second mobile antenna.

calculating in said first spatial correlator a correlation value ρ_1 between said spatial signatures a^1_p and said spatial signatures a^1_c given by:

where the symbol * represents a process of correlation of two signals.

calculating in said second spatial correlator a correlation value ρ_2 between said spatial signatures a^2_p and said spatial signatures a^2_c given by:

where the symbol * represents a process of correlation of two signals.

1 18. The method as set forth in Claim 17 further
2 comprising the steps of:

3 comparing said correlation value ρ_1 and said
4 correlation value ρ_2 in said comparator;

5 outputting from said comparator to said controller a
6 value of zero if said correlation value ρ_1 is greater than
7 or equal to said correlation value ρ_2 ; and

8 outputting from said comparator to said controller a
9 value of one if said correlation value ρ_1 is less than said
10 correlation value ρ_2 .

11 19. The method as set forth in Claim 18 further
12 comprising the steps of:

13 selecting in said controller said M spatial signatures
14 a^1_c as components of a downlink beamforming weight vector W
15 if said output value from said comparator is one; and

16 selecting in said controller said M spatial signatures
17 a^2_c as components of a downlink beamforming weight vector W
18 if said output value from said comparator is zero.

1 20. The method as set forth in Claim 19 further
2 comprising the steps of:

3 receiving in a downlink beamformer coupled to said
4 controller said downlink beamforming weight vector W from
5 said controller;

6 complex multiplying in said downlink beamformer an
7 incoming complex data stream S with said downlink
8 beamforming weight vector W ;

9 outputting from said downlink beamformer a resulting
10 complex data stream X to transmit portions of M
11 transceivers associated respectively with M antennas of
12 said adaptive antenna array.